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# A modelling study of once-bred heifer beef production

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## ABSTRACT

A case farm study of a once-bred heifer system on hill country using a spreadsheet simulation model was undertaken. Results of the feed budget and financial data of the once-bred system were compared with bull beef, 18 month heifer finishing and traditional breeding cow policies.

The once-bred heifer system generated a gross margin of $48.26/s.u. compared with $42.50/s.u. for a traditional breeding cow breeding system, $31.70/s.u. for the 20 month heifer finishing and $52.80/s.u. for a bull beef system. The once-bred heifer system produced 314 kg carcass/ha, the breeding system cow 197 kg carcass/ha, the 20 month heifer system 354 kg carcass/ha and the bull beef system 433 kg carcass/ha. The major factor affecting the profitability of the once-bred heifer system was schedule price. The best match of animal requirements and pasture growth for the once-bred heifer system was shown to occur for an October calving. This study suggests that sheep and beef farmers with traditional beef cattle policies could increase productivity by adopting a once-bred heifer beef production system.

**Keywords** Beef production, once-bred heifers, simulation model, gross margin, yearling heifer mating.

## INTRODUCTION

Recent trends have shown that New Zealand beef cattle numbers have decreased (NZMWB, 1990). This has occurred at a time when market access for beef to Asian countries, particularly South Korea and Japan, appears to have improved. To take advantage of increased market prospects, beef producing systems will need to increase output. One method of increasing the beef kill is for farmers to adopt once-bred heifer systems. The system could utilise beef x Friesian heifer calves from the dairy industry, which are usually slaughtered as four day old bobby calves. The crossbred heifer is mated at 15 months to a terminal beef sire, and after weaning is finished for slaughter at 30 months of age on the heifer/steer beef export schedule.

Once-bred heifer systems have been evaluated in Europe (Harte, 1975; Bouque *et al.*, 1980). No differences in carcass composition and meat quality between once-bred and unmated heifers have been reported (Joseph and Crowley, 1971). The once-bred heifer system has been identified as a biologically efficient (kg meat/unit of feed eaten) meat producing system (Taylor *et al.*, 1985). No information for once-bred heifer production systems in New Zealand has been published. A case farm study of a once-bred heifer beef system on hill country using a spreadsheet simulation model was undertaken. This paper presents the results of the feed budget and financial comparison of a once-bred heifer system with bull beef, 18 month heifer finishing and traditional breeding cow policies.

## MODEL SPECIFICATIONS

A spreadsheet model was developed to simulate, on a monthly basis, annual pasture production and animal feed demand. The model was formed by combining a feed budget template for a sheep and beef farm (Gray and Lockhart, 1990) with a model which derived the feed requirements of dairy cattle replacements (ARC, 1980; Brookes, 1990) using the "Quattro Pro" spreadsheet programme. Pasture data input for the model was obtained from Massey University's Tuapaka hill country farm, 10 km north east of Palmerston North. Pasture supply, expressed in terms of metabolisable energy, was a function of the monthly pasture growth rates (kg DM/ha/d) recorded over a 5 year period (Gray, 1987) and corresponding quality coefficients (MJ ME/kg DM) developed by Walker (1984), for hill country pastures. Annual pasture production was 7,500 kg DM/ha.

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Feed demand was calculated as the sum of the monthly feed requirements for each livestock class (number x daily metabolisable energy intake). Bull beef intake requirements were derived from regression equations developed by Journeaux (1987), while heifer and breeding cow intake data was obtained from Geenty and Rattray (1987). The heifer intake model was structured so that feed requirements were associated with a specified pattern of liveweight gain, date of calving and calving percentage. Differences in the monthly pattern of feed intake and total feed consumption for production systems with alternative heifer liveweight gain profiles could therefore be quickly assessed.

The feed budget analysis reported in this paper involved substitution within the cattle systems on the Tuapaka hill country unit. Sheep numbers, representing 48% of the stock units (s.u.) wintered on the farm, were fixed allowing changes in the model output to reflect the effect of changes made to the cattle policies. Each of the systems studied was constrained to achieve pasture cover levels within the range 1,000-2,000 kg DM/ha and a status quo annual feed balance (i.e. end of year pasture cover equalled that at the beginning of the year). Model output listed the total amount of pasture eaten per heifer in each age group on an annual basis and monthly pasture cover levels. For comparative purposes the annual feed requirements of the heifers were converted to s.u. equivalents by dividing by 536 kg DM (Rattray, 1978).

Gross margin (GM) analysis was used to assess the relative profitability of alternative once-bred heifer systems. The GM, calculated on a separate spreadsheet template, was defined as:

**GM = gross revenue (GR) - variable costs (VC)**

where GR = sum of the income from heifer progeny, dry (non-pregnant) heifers and once-bred heifers

VC = sum of expenses incurred for the purchase of the heifer calves and animal health (breeding, drench and pregnancy diagnosis costs).

The GM for the once-bred heifers was compared with those of a breeding cow herd, a 20 month heifer finishing policy, and a bull beef system.

## POLICY ASSUMPTIONS

### Once-Bred Heifers

The model assumes beef x Friesian heifer calves are purchased at 3 months of age (85 kg liveweight). These were artificially inseminated at 15 months (310 kg liveweight) using semen from a terminal beef sire breed. The calves were born in August-September and sold at weaning at the beginning of December (minimum 8 weeks of age). Early weaning was selected to allow the heifer to use energy previously partitioned to lactation for liveweight gain while the early sale option released capital for the purchase of replacement heifer calves.

Calving percentage within a mob is related to 15 month mating liveweight (Morris, 1980). Pregnancy rates of 80-97% for beef x Friesian heifers (265 kg liveweight) have been reported by Dalton *et al.* (1980) and Morris and Lowe (1990). For the model an 80% calf survival to weaning per 100 heifers to AI was assumed.

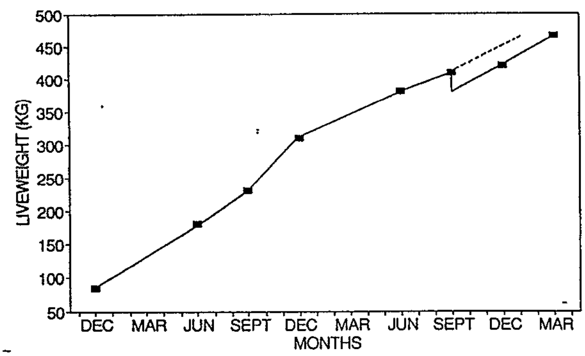


**FIG 1** Liveweights of pregnant (——) and non-pregnant heifers (- - - -).

From mid- to late-pregnancy, heifer liveweights were increased by the rate of foetal growth only. Liveweights decreased by 35 kg immediately after calving (Pleasants and Barton, 1985). A post-weaning liveweight gain of 0.5 kg/day (Pleasants and Barton, 1979) was used to enable the target slaughter weight of 465 kg to be reached. For non-pregnant heifers the same liveweight gain profile was assumed until calving, while post-calving the non-lactating heifers grew at an average rate of 0.5 kg/d until slaughter at a liveweight of 465 kg (Fig. 1).

**TABLE 1** Production and financial parameters for once-bred heifer, breeding cow, 20 month heifer and bull beef cattle policies with the same annual feed requirement.

| Parameter | Cattle Policy Once-bred Heifer | Breeding Cow | 20 Month Heifer | Bull Beef |
|---|---|---|---|---|
| Stock wintered | | | | |
| - R1 year | 257 | 84 | 446 | 393 |
| - R2 year | 257 | 68 | | 131 |
| - 2 year plus | | 338 | | |
| Meat production | | | | |
| - total (kg net) | 57,461 | 36,072 | 64,730 | 80,020 |
| - kg/ha | 314 | 197 | 354 | 433 |
| - kg/s.u. | 22.4 | 14.1 | 25.3 | 30.9 |
| Gross Margin | | | | |
| - ($) total GM | 123,456 | 108,654 | 81,152 | 136,676 |
| - ($) GM/ha | 678 | 595 | 444 | 739 |
| - ($) GM/s.u. | 48.26 | 42.50 | 31.70 | 52.80 |

The base schedule price for the P2 heifer grade (196-220 kg carcass weight) was 240 c/kg. The heifers' progeny were sold for $350/head. Calf replacements were purchased for $300 each. Insemination, semen and synchronisation costs for breeding amounted to $26.20/heifer, animal health $22/heifer and pregnancy diagnosis $2/heifer. Heifer losses from purchase to slaughter were 5%. The sensitivity of the GM to changes in schedule prices, carcass grade and weight at slaughter, calf purchase price and calving percentage were estimated by two-way parametric analysis.

### Breeding Cow Herd

The GM was derived for a herd comprising of Angus cows with a mean herd liveweight of 460 kg at the start of July. A calving percent of 80% (calves weaned/cows mated) was assumed and all progeny except for replacement heifers were sold at weaning in early April at 180 kg liveweight. Other assumptions included; a replacement rate of 20%; heifers mated at 27 months of age; a cow to bull ratio of one to forty and a sire life of four years.

### Twenty Month Heifer Finishing Policy

The 20 month heifer finishing policy assumed beef x dairy heifers were purchased at 3 months of age and sold at 20 months of age at 200 kg carcass weight to the local trade market.

### Bull Beef System

The bull beef GM was based on the bull beef system used on the Tuapaka hill unit (Grant, 1990). Friesian bull calves were purchased at 3 months of age and two thirds of these were sold at eighteen months of age at 230 kg carcass weight. The remaining one third were taken through a second winter and sold at 30 months of age at 300 kg carcass weight.

## RESULTS AND DISCUSSION

### Beef Production and Financial Returns

The feed budget analysis indicated that 257 heifers could be farmed to achieve the liveweight gain profile described in Figure 1. This equated to 2,560 cattle s.u. which produced a net carcass weight of 57,461 kg of beef (Table 1). The wintering numbers for this heifer system included 257 one year heifers and 257 two year heifers (80% of which were pregnant). In comparison, a breeding herd of 406 cows could be carried with an annual net meat production of 36,072 kg, or 524 bulls

**TABLE 2** Gross margins for once-bred heifers at (a) different schedule prices and calf purchase prices and (b) different liveweight gains and calving percentages.

(a)

| | Schedule Price ($/kg carcass wt) | | | | |
|---|---|---|---|---|---|
| Calf Purchase Price ($/calf) | 2.00 | 2.20 | 2.40 | 2.60 | 2.80 |
| 250 | 44.07 | 48.67 | 53.28 | 57.89 | 62.50 |
| 275 | 41.56 | 46.16 | 50.77 | 55.38 | 59.99 |
| 300 | 39.05 | 43.66 | 48.26 | 52.87 | 57.48 |
| 325 | 36.54 | 41.15 | 45.75 | 50.36 | 54.97 |
| 350 | 34.03 | 38.64 | 43.24 | 47.85 | 52.46 |

(b)

| | Liveweight Gain Performance (c.f. base system) (% change) | | |
|---|---|---|---|
| Calving Performance (%) | -10 | 0 | +10 |
| 70 | 43.65 | 45.31 | 46.58 |
| 80 | 46.77 | 48.26 | 49.46 |
| 90 | 49.99 | 51.37 | 52.02 |

(393 rising one year and 131 rising two year bulls wintered) could be supported with an annual net production of 80,020 kg of carcass meat, or 446 20 month heifers could be grown with an annual net beef production of 64,730 kg.

The GM for the once-bred heifer system was $48.26/s.u. (Table 1). The comparable GM's for breeding cows, 20 month heifers and bull beef were $42.50, $31.70 and $52.80 respectively.

## Pattern of Feed Supply and Demand

The annual pattern of pasture feed supply and animal requirements for once-bred heifer beef with an August 1 or October 1 commencement to calving is shown in Figure 2. Pasture production was surplus to feed requirements during spring (September - October), and less than animal requirements in mid-summer and winter (June-July). Delaying the calving date increased late spring feed demand providing a better match with pasture growth, and would be more likely to facilitate ad lib feeding of heifers post-calving.

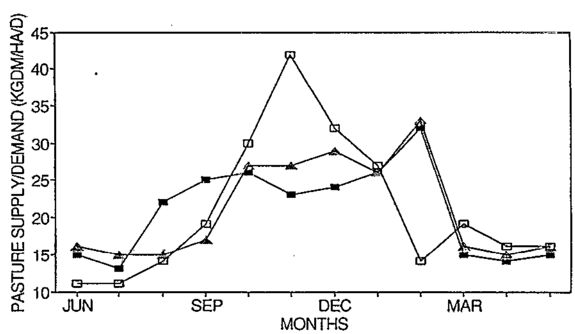


**FIG 2** Total feed demand for a heifer herd with 80% calving in either August (—■—) or October (—▲—) and (—⊟—) pasture growth rate.

At equivalent stock units wintered the once-bred heifer policy resulted in a pasture cover pattern intermediate between that of breeding cows and a two-year bull beef policy. The feed demand for a once-bred heifer policy could be reduced through the spring period by selling non-pregnant heifers for the local beef trade and in the longer-term by delaying calving date (Figure 2).

**Financial Sensitivity Analysis**

The schedule price received for heifer beef had the largest effect on the once-bred heifer GM (Table 2). A $0.20/kg (8%) reduction in the schedule reduced the GM by $4.60/s.u. (9%), while a $25 increase (8%) in the purchase price for calves moderately decreased the GM by $2.51/s.u. (5.1%). Poor grading of heifer carcasses had a lesser effect e.g. if 10% of the calved heifers graded as manufacturing rather than P2 then the GM was reduced by $1.00/s.u. A similar reduction in the GM would occur if all of the non-pregnant heifers were to be graded overfat. Improving the calving percentage had a larger impact on profitability ($3.11/s.u. for a 10 percentage unit change in calving %) than improving the rate of liveweight gain ($1.20/s.u. for a 10% change in liveweight gain) (Table 2).

## CONCLUSION

Once-bred heifer beef production appears to be a viable alternative for sheep and beef cattle farmers. Profitability of the system is higher than that achieved with traditional breeding cow and heifer beef finishing systems.

The feed budget analysis demonstrated that the feed requirements for a once-bred heifer system could be met on the hill country case farm, and indicated that a monthly pattern of pasture cover intermediate between that of bull beef and breeding cows and typical of a North Island summer-moist hill country could be expected (Milligan *et al.*, 1987). The major grazing management challenge will be for farmers to provide high quality pasture for replacement heifer calves to ensure that target liveweights are achieved. However, results for dairy bull beef policies on hill country indicate that these targets can be realised with good management (Grant, 1990).

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